UC SANTA BARBARA
THE Current

July 25, 2018
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Hands-On Summer

Summer is usually a time to unplug, hang out and play. But for the high school students in UC Santa Barbara's Research Mentorship Program (RMP) and its sibling, the Science & Engineering Research Academy (SERA), summer offers the perfect opportunity to kick the learning into high gear and get a leg up on their academic futures.

"It's been really busy," said Lina Kim, who directs both programs. For a few weeks (six for RMP, four for SERA), students from high schools near and far participate in real-world research projects led by faculty, graduate students or postdocs. The research covers a wide variety of topics throughout engineering and the sciences, as well as — new this year for SERA — the social sciences. At the end of their sessions, Kim said, the students walk away with skills that can give them a boost in their future scholastic endeavors.

"They learn to write papers and communicate their findings, and they network," Kim said, in addition to learning the nuts and bolts of research and experimentation. The programs also aim to inspire students with presentations of ongoing UCSB research and to give the students a chance to sample the researcher's life before college.

"I thought it would be a great opportunity to explore my options," said SERA student and prospective engineer Alexandra Huynh. Students in both programs are asked to choose their top preferences when they apply, ensuring they are matched to one of those tracks for the summer. Often brand-new to their fields, SERA students are given the fundamentals in their selected tracks, which explore current topics from

engineering to life sciences and microbiology to global conflict and international relations.

For participants Yixin Zou and Joyce Chen, SERA offers an opportunity for them to explore their nascent interest in chemistry and how that course of study could play out in an increasingly interdisciplinary science world.

“The track I’m taking mixes all the topics I’m interested in, so I wanted to try it out and gain some experience,” Zou said.

To give participants a full-spectrum experience, SERA begins with lectures, then dives straight into the laboratory to reinforce the concepts students just learned, often in new and innovative fields, such as soft robotics — where traditional metal parts and actuators are replaced with more pliable polymers and fluid materials.

“I just think it's really interesting to make robots out of stuff that's not what you would imagine a robot is made of,” said Rebecca McKinny, a participant in the polymer research track.

SERA’s new social sciences track delves into ultra-relevant, current world issues, such as the origins of and drivers behind global conflict. According to Kim, the program offers training in not just the examination of global issues, but also in research methods and writing about them.

“I was clueless when I first came here,” said Victoria Miller, whose interests lie in the relatively new concept of climate change-based conflict. “I didn’t even know what an abstract was.” That changed for her in the second half of the SERA program, when the students swap lab time for group discussions to suss out an approach to their research papers, investigate their findings and develop presentations in a formal capstone seminar.

For these driven and academically strong students, the six-week Research Mentorship Program offers a deeper dive into the researcher’s life. Under Kim’s direction, the 24 year-old RMP has become more focused on real-world research and interaction at the university level, with projects and relationships that go beyond the classroom. Mentors actively conducting research train their students on current techniques and data collection with state-of-the-art equipment, enter into interdisciplinary collaborations. The effort has produced full-fledged, student-authored original research, which has appeared in scientific journals.

“I thought it would be cool to learn a lot about something completely new,” said high school senior-to-be Roxy Jackson-Gain, whose research focuses on oxide films grown by molecular beam epitaxy. With strengths in chemistry, Jackson-Gain elected to push beyond her comfort zone this summer with a topic that also incorporates physics and has real-world impacts in the design and fabrication of tomorrow’s power electronics.

Meanwhile, Jason Goodman and Tobie Jessup are getting a crash course in collaboration as they investigate related but separate aspects of the intricate sexual selection behavior of tiny crustaceans called ostracods. Goodman studies video of the mating behavior of these “seed shrimp” and performs data analysis, while Jessup focuses on the genetic basis of these behaviors. Together they hope to shed light on behaviors that various ostracod species exhibit in their complex mating displays.

“Researchers have learned the differences in where and how ostracods perform these bioluminescent displays but no one has studied their genetic basis, so we’re seeing if these small genetic variations can result in very different complex traits as a mating display,” Jessup explained.

In exchange for the potentially long hours of research, which often include library time and fieldwork, RMP students can use their experience for college credit, putting them ahead of the game before they even start. In addition, RMP work can be included in college applications and used in competitions. It also can have a more immediate benefit for those looking to refine skills they already have.

“I’m in the computer science academy in my high school, so a lot of the programming work that I do here is cross-applicable,” said Jake Trimble, who is writing programs to process the massive amount of genetic data collected on microbes sampled from the U.S. Department of Energy’s Joint Genome Institute. The work, he explained, will go toward greater understanding of the multitude of microorganisms that are integral to every ecosystem on Earth.

Some mentoring relationships go beyond the six-week duration of the program. When RMP veterans Kayetan Chorazewicz and Sameer Sundrani came to the end of their session with materials scientist Kollbe Ahn, they knew they had some special research going with their bioinspired polymer system, one that promises increased strength without sacrificing flexibility and vice-versa.

“If it wasn’t for Kollbe allowing us to continue with our work even after we were done with the program, we wouldn’t have been able to publish in a journal,” said Chorazewicz, who with Sundrani continued to conduct research and write. Their resulting paper, “Bioinspired Functional Gradients for Toughness Augmentation in Synthetic Polymer Systems,” appears in the journal Macromolecular Chemistry and Physics.

Not every SERA or RMP participant’s work immediately results in a paper, but all the students come away with a significant summer experience, and perhaps even inspiration they can carry into their futures. Such was the case for SERA student Brenda Zhao, who admitted that she “wasn’t necessarily determined to pursue a career in engineering or science.” But a visit to Apeel Sciences, a startup spun off from the UCSB Department of Chemical Engineering, opened her eyes to the vast potential of a career in science or engineering.

“You can take engineering in so many creative and fascinating ways and I feel like I know what I want to do now,” she said. “I’ve never been more inspired in my life.”

About UC Santa Barbara

The University of California, Santa Barbara is a leading research institution that also provides a comprehensive liberal arts learning experience. Our academic community of faculty, students, and staff is characterized by a culture of interdisciplinary collaboration that is responsive to the needs of our multicultural and global society. All of this takes place within a living and learning environment like no other, as we draw inspiration from the beauty and resources of our extraordinary location at the edge of the Pacific Ocean.